# Run IIb Detector Upgrade Installation

## Orientation

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on behalf of the DØ Collaboration

# Run IIb Detector Upgrade

- Run IIb Upgrade Project is a suite of upgrades designed to prepare the DØ detector to effectively handle larger integrated and instantaneous luminosities
  - Tracking Upgrades
    - Layer 0 Silicon Detector
    - Enhanced front-end boards for Central Fiber Tracker (AFE II)
  - Trigger Upgrades to keep trigger rates in check
    - Level 1 ---Central Track Trigger, Calorimeter Trigger, Cal Track Match
    - Level 2 ---Silicon Track Trigger, Processor Upgrades
  - DAQ/Online System Upgrades to handle data rates

See talk by D. Wood

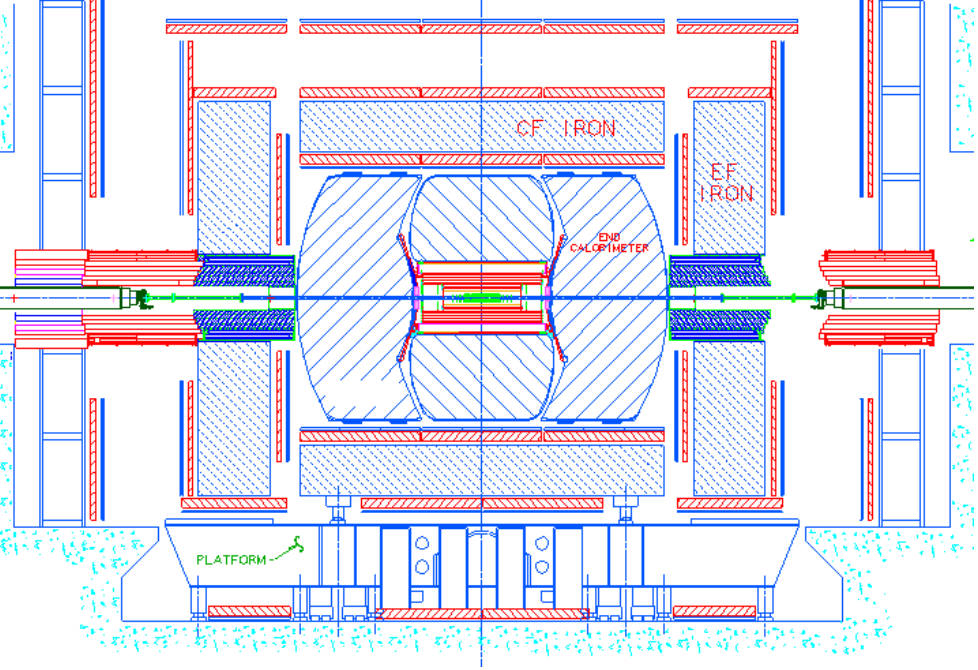
- Installation is not formally part of the Upgrade Project
  - But the dedicated people who have produced the upgrade are essential to effective and timely installation, commissioning and operation of these upgrades
  - Personnel who have been responsible for various aspects of the upgrade project are involved in overseeing the installation and commissioning efforts

# Layer 0 Silicon

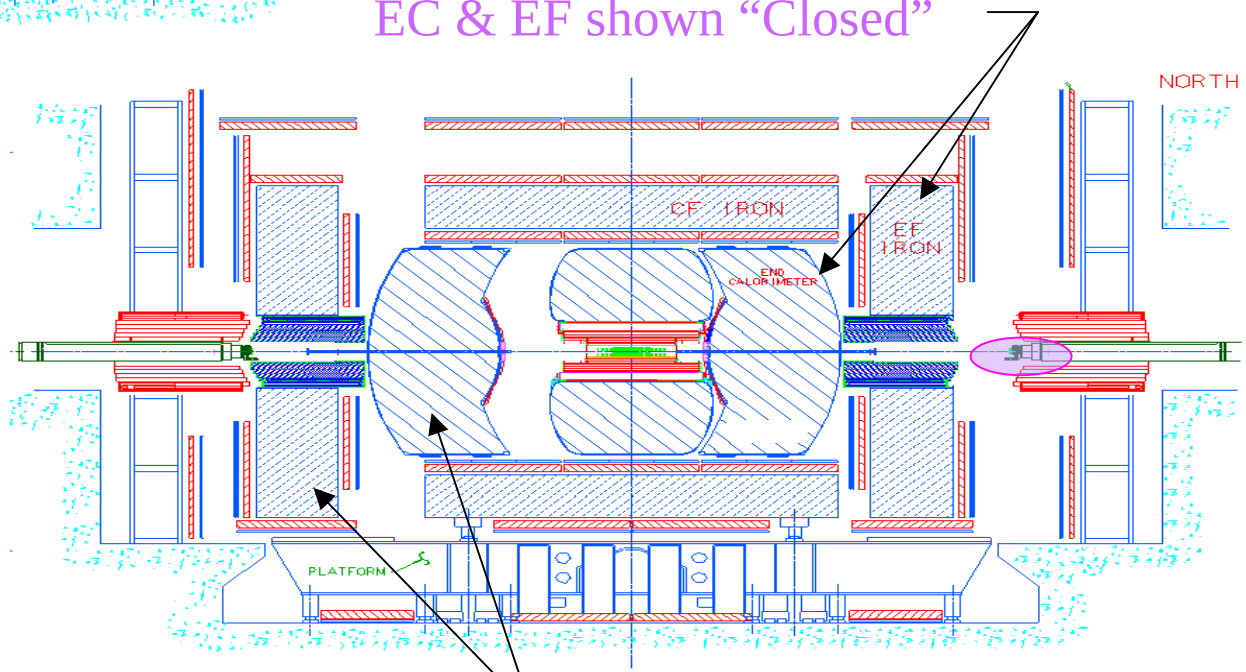
- Detector
  - Additional layer of silicon detectors designed to fit inside the current Silicon Microstrip Tracker
    - Mitigate tracking losses due to radiation damage and detector aging
    - Provides more robust tracking and pattern recognition to accommodate higher instantaneous luminosities
    - Improves impact parameter resolution
  - 12288 channels
  - Completed assembly undergoing final mechanical and electrical tests
- Installation
  - Tight clearances and substantial work handling and surrounded by delicate components
    - Requires detailed planning, numerous detector reconfigurations, and significant expertise, tooling and technique developments
  - Compromises Tevatron vacuum
  - Requires significant collision hall access

See talk by R. Lipton

See talks by B. Cooper and L. Bagby




EC & EF shown "Closed"




This EF & EC "Open"

# Central Track Trigger

- Level 1 Central Track Trigger Upgrade
  - Replace 40 Digital Front End Analog Boards and associated infrastructure with DFEA2
    - improve fake rejection capability of Central Track Trigger at higher occupancies due to increasing instantaneous luminosities
      - makes use of full granularity of Central Fiber Tracker inputs
  - All hardware produced and tested
  - Two DFEA2 boards were running on platform with signals from splitters for many months, and results have been verified against performance of current boards
- Installation
  - Requires several weeks of collision hall access to remove current boards and install replacements
    - Activity on platform will not interfere with Layer 0 installation
  - Requires intermittent access thereafter for debugging and verification of cabling

See talk by S. Gruenendahl

# Calorimeter Trigger

- Level 1 Calorimeter Trigger Upgrade
  - Replace 10 racks of Run I calorimeter trigger electronics
    - 80 Analog to Digital Filters (ADFs)
    - 8 Trigger Algorithm Boards (TABs)
    - 1 Global Algorithm Board (GAB)
    - Sharpens trigger turn-on curves
    - Provides specific object ID at Level 1 (electrons, jets, taus)
  - System testing of upgraded Level 1 trigger electronics using signals split from detector in progress on sidewalk outside Movable Counting House
- Installation
  - Does not require collision hall access
    - Trigger racks located in Movable Counting House
  - However, new electronics physically displaces current Level 1 Calorimeter trigger electronics

See talk by A. Stone

# More Trigger Upgrades

- Level 1 Calorimeter Track Match
  - Electronics to provide new capability to match calorimeter and track objects at Level 1
    - Improved rejection and tau triggering capability
  - System testing in progress
  - Installation nearly complete
  - Requires change in trigger timing to accommodate this upgrade
- Level 2 Silicon Track Trigger
  - Additional electronics to include Layer 0 detector inputs in Silicon Track Trigger
  - To be installed in Movable Counting House
- Level 2 Processor Upgrades
  - Facilitates handling of more complex events and implementation of improved algorithms
  - Installation in progress (no collision hall access required)

# Run IIb Detector Upgrades

- DAQ/Online upgrades to facilitate handling higher instantaneous luminosities and increased data rates
  - Enhance Level 3 processor power
  - Upgrade database and host servers
  - Upgrade slow control system processors
  - These upgrades have been implemented without significant interruption of other ongoing activities
- AFE II (Analog Front End II)
  - Replacement for readout electronics for Central Fiber Tracker
    - To address saturation, pedestal shifts and enhance performance
    - Designed to be plug compatible with current AFE to allow adiabatic installation during brief accesses (~200 boards to be installed)
    - Still in prototype phase
    - Had been planning to install and test prototypes on platform in collision hall during December or January
      - Will still likely want to perform these tests prior to production
        - » Requires short accesses
      - Installation not currently scheduled to occur during the upcoming shutdown

# Project Status

- Project is making impressive technical progress
  - All components of the trigger are built and benchtested
    - Most components have already been tested at DØ
    - Extensive integration tests ongoing to ensure smooth turn on after installation
  - Layer 0 fully assembled
    - Electrical and mechanical tests ongoing
    - Installation tooling in final phases
  - Online systems on schedule

Excerpt from presentation by V. O'Dell on Run IIb Project Status At International Finance Committee Meeting on 20 October 2005

# Installation Strategy

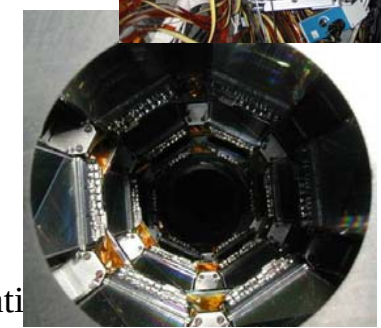
- Minimize integrated luminosity cost
  - Take full advantage of the suite of upgrades as soon as possible
  - Use mock-ups and perform system tests where feasible to reduce risk and installation/commissioning time
  - Simultaneous installation of disruptive upgrade components as rapidly as can be safely and reliably accomplished

# Preparing for Installation

- Layer 0 clearance measurements during 2004 shutdown
  - Provided valuable experience for team that will be involved in this installation
  - Provided insights that are integrated into the shutdown schedule
- Mock-ups of relevant regions of detector to exercise tools and procedures for Layer 0 installation
- Infrastructure development and system testing
  - Full system technical commissioning prior to installation
  - Parallel slice tests for Level 1 Calorimeter trigger
    - Splitters provide signals from detector
  - In-situ tests
    - Readout of Layer 0 modules mounted in collision hall during 2004
    - Testing of parallel Level 1 Central Track Trigger slice implemented using signals from detector
  - Developing upgrade version of strawman trigger list
    - Pushing development of software

# Layer 0 Installation

- Shutdown duration driven by Layer 0 installation
  - Layer 0 installation involves tight clearances (<1mm), long objects (~2 m) and complex and infrequently performed operations
  - For sake of personnel, detector and Tevatron program, these tasks must be performed carefully and safely
  - Numerous reconfigurations of large DØ detector elements
  - Much of the activity in tight space surrounded by delicate equipment
    - requires body awareness and attention to detail
  - Several delicate operations
    - Some activities require long arms and steady hands
  - Significant expertise required



# Installation Schedule

- Installation schedule implemented in MS Project
  - Assumes 5 day work week
  - Includes lab holidays
  - Parallel tasks implemented where detector configurations allow
  - 14 week duration
    - Second shift activities when appropriate
    - ~25% schedule contingency
- Maintenance activities must also be integrated into the shutdown planning
  - These activities will be interleaved appropriately

See talk by R. Smith

# Scheduling the Shutdown

- Now that the lab shutdown schedule has been firmly established, the lab and the collaboration are in the process of refining understandings of resource availability and assignments
  - A firm date is clearly important for certain aspects of planning
- The shift in schedule does have impact on plans
  - Travel arrangements/visas
  - Sabbaticals
  - Students and post docs
  - We have requested assistance in adjusting to this shift
    - Resources
    - Access for AFEII testing
- Make effective use of situation
  - Move towards incorporating test systems into routine operation
  - Plan to go through practice round of Layer 0 installation at mock-up just prior to the start of shutdown as a refresher

# Summary

- Upgrade preparations are well advanced
  - Layer 0
    - Mockups and associated tooling developed and tested
    - Exercising/refining Layer 0 installation techniques
  - Trigger
    - Running system tests
- Installation shutdown preparations are well underway
  - 1 March 2006 through 6 June 2006
  - 14 week duration
  - The installation schedule includes approximately 25% schedule contingency in the 14 week shutdown duration (including Saturdays and double shifting)
    - This level of contingency is not excessive given the nature of the tasks to be undertaken
    - We plan double shift operations in attempt to bank some of this contingency
  - Successful installation will depend upon vigorous participation of collaborators and significant lab support